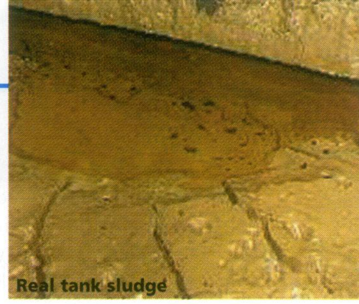
HAZARDOUS WASTE

Making Fake Sludge

With all the real waste lying about, it might seem strange for chemists to create artificial waste. But that's exactly what's being done as part of the effort to ameliorate the seemingly intractable problem of radioactive contamination at Hanford Nuclear Site in southeastern Washington State.

Cleaning up 55 million gallons of radioactive waste stored in tanks is a key task at the Hanford site, which the site's owner, the Department of Energy (DOE), calls "the world's largest environmental cleanup project." The Hanford site houses aging reactors and other leftovers of a 40-year project to make plutonium for nuclear bombs, including tanks full of sludge, mixtures that formed from dissolved solid radioactive wastes, such as spent fuel rods, and the solutions used to process the wastes. The 177 tanks at Hanford contain different types of sludges resembling wet plaster, concrete, or peanut butter, says Jim Krumhansl, a geochemist at Sandia National Laboratories in Albuquerque, New Mexico.

The huge tanks were not designed as permanent storage. The DOE says at least one million gallons of liquid from the tanks has already reached groundwater and may eventually threaten local groundwaters bisecting the Hanford site. In October 1999, the DOE's Office of River Protection reported finding high levels of radioactive technetium-99 in groundwater near one group of tanks.


Real tank sludge

Jun Liu/Pacific Northwest National Laboratory

The tanks present a dilemma. Doing nothing perpetuates the threat to groundwater. But mixing or moving the sludge carries all the risks of working with large quantities of highly radioactive material (including spills and exposures to humans and the environment). And laboratory research is hobbled by expensive radiation-protection precautions. The cleanup costs at Hanford—for tanks and other projects—totaled $1.6 billion in FY 1999 alone.

In order to research the chemistry needed to decommission the tanks, Krumhansl and colleagues have started brewing artificial sludge. The work is an outgrowth of the DOE's Environmental Management Science Program, started in 1996 to provide a basic research perspective on nuclear waste cleanup problems that might ultimately cut the cost of remediation. In addition to cutting costs, the research aims to answer two critical problems: what will happen to radioactive isotopes remaining after cleaning and how can their migration at a later date be minimized?

Coinvestigator Kathryn Nagy, a geochemist at the University of Colorado at Boulder, is making simple sludge—chiefly iron and aluminum—in a basic, high-nitrate system. To represent technetium-99, an isotope found in tanks and groundwater at Hanford, Nagy is using the safer, nonradioactive rhenium, which behaves like technetium in chemical reactions.

One goal of her work is to learn whether the radioisotopes are more concentrated in the liquid or solid portion of the sludge. She says this information will be useful in determining whether chemical or physical treatments are needed to maximize radioisotope removal from the tanks.

The investigators are also trying to learn what will happen to radioisotopes in the sludge that remains after the tanks have been emptied. "The tanks will be sluiced, sloshed, and squirted, but people won't be sent inside to clean them up," says Krumhansl. "There will be some percentage that sticks to the bottom and sides." Krumhansl has made artificial sludge in which nonradioactive isotopes of cesium and strontium substitute for radioisotopes of those elements. "I try to come up with what it is about sludge that holds onto radioisotopes, and how much will leach out [from residual sludge]," he says. "This is a tool to figure out what is going to be left, and how much of that radiation will leave to get into the groundwater."

Krumhansl says that doing this research on nonradioactive artificial sludges is much less expensive than working with the real thing, as well as immeasurably safer. "Once this information is available," he says, "we can assess just how clean we need to get the tanks, and not spend any more than necessary on the project."
–David J. Tenenbaum

WATER POLLUTION

Menace of Microbes

Scientists and policy makers from throughout the environmental health community are engaged in a debate on the focus of government water hazard research and the direction of efforts to protect the safety of the nation's drinking water. Joan B. Rose, a professor of marine sciences at the University of South Florida in St. Petersburg and coauthor of *Microbial Pollutants in Our Nation's Water Supply: Environmental and Public Health Issues*, a report issued by the American Society for Microbiology in January 1999, says, "We think a lot more needs to be done up front to prevent water contamination, to look at water quality and safety from a microbial standpoint before you get to the outbreaks." Proponents of this idea base their position in part on information contained in the report, which says that a constellation of scientific, legal, and perceptional problems are permitting harmful microbes to threaten the safety of the nation's drinking water.

One key problem in understanding and combating the spread of microbial diseases is the uncertainty about their prevalence. Contrary to estimates by the Centers for Disease Control and Prevention (CDC) of up to 900,000 cases of waterborne infection and possibly 900 deaths annually in the United States, a meta-analysis presented at the 1994 International Symposium on Groundwater, held in Rome, concluded there may be more than seven million cases per year. One possible reason for the disparity is the CDC's use of passive surveillance by relying on state health departments to report infections, says Erik Olson, a senior attorney with the Natural Resources Defense Council who is familiar with the report. Olsen says such reporting fails to provide a good snapshot of the extent of a disease.

For too long, says Rose, the emphasis has been on cancer and on chemicals such as industrial solvents and pesticides rather than on chronic and severe outcomes such as myocarditis, reactive arthritis, neurological impairments, and microbial diseases caused by environmental contamination with poorly treated sewage, septic tank leakage, stormwater, and animal waste. While counseling balance, Dennis Juranek, associate director of the Division of Parasitic Diseases at the CDC, agrees that new tools are needed to look for waterborne viruses and protozoa. He observes that few studies have been funded to look at the microbial risk of waterborne disease. Stephen Schaub, a senior microbiologist in the EPA's Office of Water, notes that the EPA is funding drinking water microbial epidemiology studies, some of which will be conducted by the CDC. In addition, the EPA, with others, is now evaluating viruses, protozoa, and indicator data to estimate national pathogen occurrence levels in drinking source waters.

Compounding the scientific and technical problems is a perception problem, says Schaub. "For the most part, people don't consider the United States to have any really major problem associated with microbial waterborne disease. They are more aware of chemical hazards being a concern," he says. Rose says that many people view infections as "natural" and treatable. Carcinogenic chemicals are seen as much more frightening even though, she says, microbes can pose a greater risk.

Juranek points out that it is only relatively recently that scientists have begun to realize that some microbes are capable of eluding even modern treatment equipment in big cities. Viruses can elude barriers such as sand and soil and taint well water, which is used by about half the population. This, argues Olson, means stricter attention must be paid to well contamination from sources such as feedlot runoff and manure lagoons, which can contaminate groundwater. Schaub says that the EPA is aware of the potential for viruses to migrate to groundwater and plans to propose future rules to address the problem. **–Harvey Black**